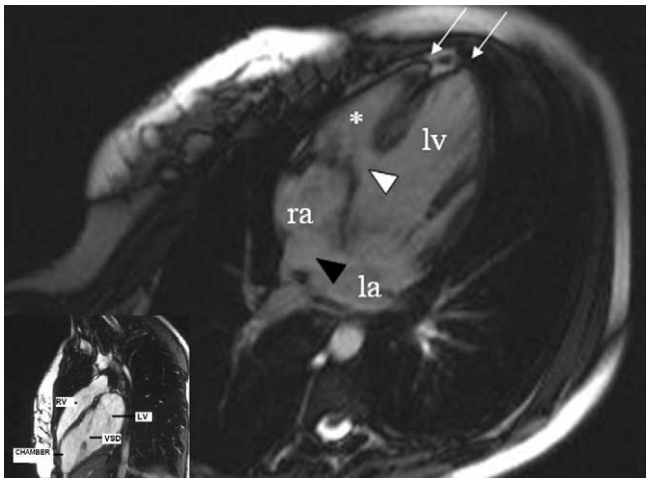

Figure 2. Cardiac MRI of the patient. *ra,* Right atrium, *lv,* left ventricle; *la,* left atrium; *white arrow,* VSD; *black arrow,* ASD; *third chamber.

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A novel aortic arch reconstruction method for double-inlet left ventricle with interrupted aortic arch and restrictive bulboventricular foramen

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Author photo

Patients with a functional single ventricle, unrestricted pulmonary blood flow, and aortic arch obstruction require staged palliation aimed at the Fontan circulation. Obstruction of the bulboventricular foramen (BVF), the communication between the left ventricle and the rudimentary right ventricle, may complicate the clinical course of patients with double-inlet left ventricle (DILV).[1] In this report we present a new reconstructive approach for such morphology, applying a modification of the Damus-Kaye-Stansel procedure combined with arch reconstruction by suturing the ascending aorta to the descending aorta. This modification is called the swing-back technique.

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Clinical Summary

The patient was a neonate (14-day-old boy weighing 3.0 kg) in whom situs solitus, atrioventricular and ventriculoarterial discordance {S,L,L}, DILV with a rudimentary right ventricle, transposition of the great arteries (TGA), restrictive BVF, patent ductus arteriosus, retroaortic innominate vein, and type A interrupted aortic arch (Seroria-Patton classification) were diagnosed. The diameters of the ascending aorta, main pulmonary artery (PA), and descending aorta were 9.1, 14.5, and 9.8 mm, respectively, and the BVF area index was 1.39 cm^2/m^2. The morphologic diagnosis was based on the evaluation of 2-dimensionalechocardiography and multislice computed tomography.

Surgical Technique

After median sternotomy, cardiopulmonary bypass was instituted with dual arterial cannulations: one cannula was placed into the brachiocephalic artery and the other was placed directly into the

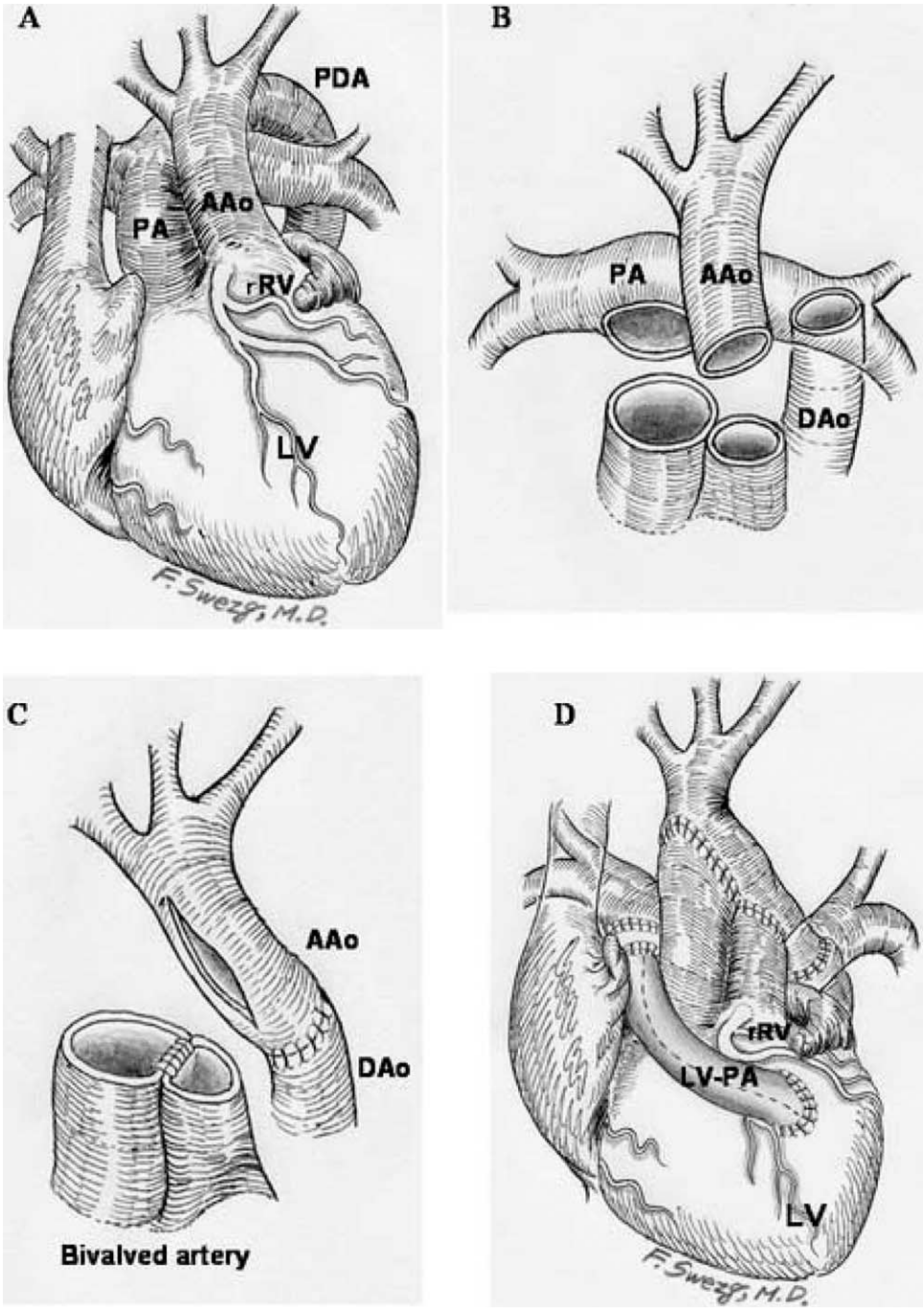

Figure 1. A and B, First schema of the surgical procedure. A, Gross anatomy. B, The PA was transected at the level of bifurcation, and the AAo was transected at the level with proximal stump of the main PA. C and D, Second schema of the surgical procedure. C, The DAo was anastomosed to the distal stump of the AAo in end-to-end fashion, and the aortic root and pulmonary trunk were connected in side-to-side fashion. D, The bivalved artery arising from both ventricles was anastomosed to the new aortic arch, and an LV–PA conduit was placed. *AAo,* Ascending aorta; *DAo,* descending aorta; *LV,* left ventricle; *LV-PA,* conduit placed between left ventricle and pulmonary artery; *PA,* pulmonary artery; *PDA,* patent ductus arteriosus; *rRV,* rudimentary right ventricle.

descending aorta. After the patent ductus arteriosus was ligated and divided, cardiac arrest was achieved by cold crystalloid cardioplegia. The atrial septal defect was enlarged through the right atrium, and the main PA was transected at the level of the bifurcation. An expanded polytetrafluoroethylene nonvalved conduit 5 mm in diameter and incorporating a cuff was connected to the distal stump of the PA in end-to-side fashion. The neck vessels were snared, and the brachiocephalic trunk was perfused to maintain cerebral circulation. The ascending aorta was transected at the level of the proximal stump of the main PA. The descending aorta was dissected and clamped (Figure 1, *A* and *B*). After ductal tissue was excised, the descending aorta was anastomosed to the distal stump of the ascending aorta in end-to-end fashion (swing-back technique). The aortic root and pulmonary trunk were connected in side-to-side fashion by continuous suture with careful attention to the coronary ostia and valve commissures. The newly formed bivalved artery arising from both ventricles was anastomosed in end-to-side fashion to the underside of the new aortic arch. After the arch reconstruction was completed, a sufficient diameter core of free wall myocardium was removed from the left ventricle with great care not to injure the pulmonary valve, the coronary artery, or the mitral valve chordae. Proximal anastomosis of the PA to the conduit was performed with a running suture to provide pulmonary flow from the left ventricle (Figure 1, *C* and *D*). After evacuation of the air from the ventricles, all neck vessel snares were released, and coronary arterial perfusion was reinstituted.

The patient had an uneventful postoperative recovery and underwent bidirectional superior cavopulmonary anastomosis at 3 months of age, weighing 4.2 kg. Postoperative multislice computed tomography and 2-dimensional echocardiography revealed an unobstructed aortic arch and normal functioning semilunar valves.

Discussion

The initial surgical treatment in children with levo-transposition of the great arteries, DILV, rudimentary right ventricular outflow chamber, and restrictive BVF with aortic arch obstruction must address arch reconstruction, limit pulmonary blood flow, and secure systemic blood flow. This can be achieved by several reported methods. van Son and colleagues[2] reported a modified technique for aortopulmonary anastomosis applying the Damus-Kaye-Stansel procedure with aortic arch augmentation with a triangular pulmonary homograft patch. Jacobs and colleagues[3] described a modified Norwood procedure in which augmentation of the inner aspect of the aortic arch and PA-aorta anastomosis are accomplished with two separate patches of PA homograft. Thistlethwaite and colleagues[4] used another modified Norwood procedure in which the aortic arch is augmented with a pulmonary homograft patch and the proximal end of the ascending aorta is anastomosed end-to-side to create a junction between the native PA and homograft patch.

In comparison with reported methods, the technique we described herein has the following advantages: (1) reconstruction of the aorta without the use of artificial patch material; (2) minimal dissection and mobilization of the descending aorta to perform arch reconstruction without tension; and (3) suture line of minimal length to minimize the risk of excessive bleeding. Our technique, in which the ascending aorta is directly connected to the descending aorta, was first introduced by Liddicoat and colleagues[5] in the case of the Taussig-Bing anomaly associated with transposition of the great arteries and interrupted aortic arch. If a discrepancy in size exists between the ascending aorta and the systemic outflow orifice from the ventricles, this procedure is considered useful, although hypoplasia of the ascending aorta that results in a size discrepancy between the ascending and descending aortas precludes this method. The long-term outcome of this procedure in terms of aortic arch distortion, regurgitation of semilunar valves, and left bronchial stenosis is unknown. Careful follow-up is necessary.

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